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Differences in Interpersonal Skills Between Engineering and Organizational Leadership and Supervision Majors

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ABBREVIATIONS

OLS – Organizational Leadership and Supervision

COE – College of Engineering

EDA – Exploratory Data Analysis

RAS – Rathus Assertiveness Schedule

OCCI – Organizational Communication Conflict Instrument

SO – Solution Oriented

NC – Non-confrontational

ABSTRACT

Mhaskar, Anuj Ajay. M.S., Purdue University, August 2010. Differences in Interpersonal Communication Skills between Engineers and Organizational Leadership and Supervision Students. Major Professor: Rodney Vandeveer.

This study explored the differences in interpersonal communication skills – assertiveness and conflict management in particular between students with a senior academic standing in the college of engineering and the department of organizational leadership and supervision at Purdue University, West Lafayette. The Rathus Assertiveness Schedule and the Putnam-Wilson OCCI were used to measure assertiveness levels and conflict management styles in students. Results from the study indicated that there is no significant difference in assertiveness levels or the use of conflict management styles between the two majors. However, significant differences in assertiveness levels and the control scale of conflict management were found between males and females.

CHAPTER 1. INTRODUCTION

This chapter lays the foundation for the study to be conducted. The topics covered in this chapter include the research question, the scope and significance of the study, the assumptions, limitations and delimitations, and key definitions.

1.1. Research Question

Is there a difference in interpersonal communication skills between engineering and OLS majors?

1.2. Scope

This research will look at students from the college of Engineering and the Department of Organizational Leadership and Supervision classified with a senior standing at Purdue University. Specific interpersonal communication skills - assertiveness and conflict management style in particular, will be measured through multiple surveys, and the results will then be compared between the two majors.

1.3. Significance

It is often said that engineers do not have adequate communication skills as compared to other non-technical employees in an organization. However, communication belongs to a larger spectrum of interpersonal skills, and has many different aspects to it, both verbal and non-verbal. According to Robbins and Hansaker (2009), interpersonal skills include self-awareness, communicating, motivating, leading, team concepts, and problem solving. Guilar (2001) further categorizes interpersonal communication skills into listening, assertiveness, conflict resolution, and collaboration or team work. The difference in these aspects of interpersonal communication skills between engineers and other majors has not been studied as yet.

The results of this study will shed light on the differences in two of the aspects of interpersonal communication, namely assertiveness and conflict management. These results can then be used by universities to inculcate courses on interpersonal communication in their engineering curricula. Additionally, from an industry point of view the results obtained from this study can provide a stepping stone to design or further enhance training programs for entry level engineers and even engineering managers.

1.4. Definition of Terms

Assertiveness: A dimension describing people’s tendency to speak up for, defend, and act in the interest of themselves and their own values, preferences, and goals (Costa & McCrae, 1992; Wilson & Gallois, 1993, as cited by Ames & Flynn, 2007).

Conflict: A dynamic process that occurs between interdependent parties as they experience negative emotional reactions to perceived disagreements and interference with the attainment of their goals. (Barki & Hartwick, as cited in Tjosvold, 2006)

1.5. Assumptions

The following assumptions were made while conducting the research:

- Subjects will answer the survey questions in a truthful manner.
- The level of assertiveness and conflict management style of the subjects remains the same for the first two years while working in an organization.

- The survey used to collect data will provide accurate results in relation to the model that is being used.
- The electronic survey tool used for data collection will function without any errors.

1.6. Limitations

The limitations of this research include:

- There are numerous skills that can be classified under interpersonal communication. This research focuses on assertiveness and conflict management styles due to time and resource limitations.
- The number of responses received will be able to provide conclusive data.

1.7. Delimitations

The delimitations of this research include:

- Students classified as freshmen, sophomores, and juniors will not be included in the study.
- Students outside the college of Engineering and the Department of Organizational Leadership and Supervision will not be included as subjects.
- Only students from the West Lafayette campus of Purdue University will be included in the study.
- The survey will be available online for a limited time only.

1.8. Summary

This chapter provided a brief outline of the study. It covered the research question and its significance to the industry and the academic world, the scope of the study, and certain assumptions, limitations, and delimitations that are essential to the validity of the research. Additionally, the researcher also defined certain key terms pertaining to this study.

CHAPTER 2. REVIEW OF LITERATURE

This chapter provides a review of existing literature published in the area of this study and explains the models the Rathus Assertiveness Schedule and the Putnam-Wilson OCCI are based on.

2.1. Literature Review

According to Vieth and Smith (2008) engineering managers will need to be replaced annually at a rate of 20 percent in 2014 as compared to 6.2 percent in 2003 and this increase in demand will create about 15,000 engineering management vacancies. Factors such as changing population demographics, globalization of economies, accelerated growth of technology, and increasing business demands are contributing to the growing shortage of technical managers.

> Within the next 10 years, we will experience a greater than threefold increase in leadership turnover in engineering and technical organizations, increasing the competition for an increasingly scarce resource. To remain competitive globally, technical enterprises will have to develop leaders internally. (Vieth & Smith, 2008).

One of the major reasons, cited in nearly all articles, for engineers to be formally trained as leaders is globalization. Organizations nowadays consider “on the job” leadership training an inefficient method in the global economy as it adds to indirect costs. These organizations then lose out on the cost advantage when compared to organizations outside the United States. Another major reason is the rapid rate at which technology is growing today. Additionally, according to Cetron and Davies (2008) the technical knowledge known today will amount to only one percent of the technical knowledge known in 2050. These shortages and needs place an emphasis to put into place formal leadership development training programs in large and small corporations alike.

2.2. Engineers as Leaders

A majority of today's technical leaders lack a formal leadership or management training (Vieth & Smith, 2008). Sapienza (as cited in Hurd, 2009, p. 40) argued that all technical professionals, including engineers, have certain inherent characteristics that act as hurdles when moving from their traditional roles into management positions. The first one is maintaining a strong association with their technical profession. Engineers are faced with an identity crisis when transitioning to a management role and often times refuse to let go of their former identity because of the strong association with it. They may feel disoriented and ineffective as a result of this confusion (Hurd, 2009). The second hurdle technical professionals have to overcome involves the concept of collaboration and being challenged. Engineers are not accustomed to working in a team environment and certainly not used to being challenged on their tasks. Opening up to two-way communication is a big change for a technical professional. The third challenge comes in the form of meeting organizational goals while keeping their creative problem solving skills in check. Engineers, at the very fundamental level, are taught to approach open-ended problems with a creative and independent thought process. While this works well in the technical fields, it can conflict with the efficient running of an organization. The fourth hurdle technical professionals face is their lack of people skills. Engineers are often thrust into leadership positions based on their individual technical contributions (Vieth & Smith, 2008). A lack of two-way communication during their engineering phase leaves this skill undeveloped (Hurd, 2009).

These four characteristics lead to three major challenges engineers face as leaders. The first one involves managing other people. The dual challenge engineers face within this is letting go of their involvement in the technical field and empowering their subordinates; that is, trusting and giving them the authority to make decisions. The second challenge consists of a dual aspect as well. The first aspect is working with people from different departments, and even different organizations. Engineers find it hard to relate to the thought process of an individual who is not an engineer (Hurd, 2009). The second aspect is being able to sell their ideas to these same people as opposed to instructing them on what and how to go about doing the particular task. The third challenge includes contributing the fields outside those of their technical expertise, such as marketing. Additionally, Hurd (2009) states that a lot of the business terms have an element of ambiguity attached to them, something that technical professionals dislike, which makes it even more difficult for them to use those terms in their business conversations. Hacker and Doolen (2007) reinforced the finding that project success strongly depends on the support received from the top management. Therefore, it is imperative for an engineering manager to develop as a leader, as it would equip the manager with the skills to sell the project to top management; thereby, increasing its chance of succeeding.

The changing roles of engineers in the workplace require them to have a broader range of skills as compared to engineers from previous generations. These are non-technical in nature and involve communication, problem solving, and management skills; and are equally important as their technical skills (Nguyen, 1998). The current engineering curricula are providing the industry with engineers that are different from what the industry requires. While the industry and academics see communication skills as one of the desirable attributes of an ideal engineer, the students focus more on the technical aspects. In a study conducted by Nguyen (1998), the desire for communication skills was given a rating of 86.20 and 74.50 by industry professionals and academics, respectively; whereas students gave it a rating of 48.60. According to Hissey (2002) executives are content with the technical knowledge that their engineering graduates possess, but believe they do not possess the knowledge or skills when it comes to communication. If these interpersonal communication skills in engineers can be developed at a university level, it will build the foundation required for them to transition into leadership positions.

2.3. Conflict Management

Working in an organization also means working in teams and because conflict is a social phenomenon (Pondy, 1967), it is inevitable while working in a group. However, the positive or negative nature of the conflict and its outcome is determined by how it is resolved.

Styles of handling interpersonal conflict are differentiated on two dimensions - concern for self and concern for others. This model is also known as the dual concern model (Ma, Lee, & Yu, 2008). Concern for self, also measured through assertiveness, refers to attempts to satisfy one's own priorities. Concern for others, also termed cooperativeness, refers to attempts to satisfy the priorities of others. These two dimensions combine to provide five specific conflict handling styles – Avoiding, Accommodating, Competing, Collaborative, and Compromising. An individual with an avoiding style looks to withdraw from the conflict situation; either physically, emotionally, or intellectually, or postpone it altogether. This individual ranks low on assertiveness as well as cooperativeness. An individual with an accommodating style is unassertive and gives into the opposition's argument; thus, ranking high on cooperativeness. An individual who prefers a competing style of conflict management is highly assertive and pursues his concerns at the expense of others; thereby, ranking low on cooperativeness. A collaborative style refers to high assertiveness as well as cooperativeness. An individual with this style tries to diagnose the underlying issue and arrive at a solution that fully satisfies all the entities involved. An individual with a compromising style is moderately assertive and cooperative and attempts to find solutions that partially satisfy all the entities involved (Rahim, 1983; K. Thomas, G. Thomas, & Schaubhut, 2008).

Based on Blake and Mouton’s Managerial Grid, researchers have developed five instruments that are widely used to measure interpersonal conflict management styles. On one hand the Thomas-Kilmann MODE and Ross-De Wine CMMS are based on the assumption that human dispositions remain the same irrespective of the context; hence their conflict management styles will not change according to the situation. On the other hand, the Hall CMS, Rahim ROCI-II, and the Putnam Wilson OCCI are based on the assumption that human dispositions cannot be studied across situations and conflict behavior is contextual. Additionally, the Hall CMS assumes that only one style is most effective, while the rest assume that combinations of the different styles need to be utilized for effective conflict management (Womack, 1988). Reliability for these instruments has been tested by researchers using Cronbach’s alpha, and results indicated that all the instruments except for the OCCI exhibited weak to moderate reliability. The researcher has chosen to use the Putnam Wilson OCCI because of its high reliability, explicit focus on communication, and its assumption that conflict styles are situational. Additionally, reliability and validity studies for this instrument have used a sample which contained organizational members as well as students. One weakness of the OCCI; however, is that it focuses on the intent of communication rather than specific messages (Womack, 1988).

A principle components-factor analysis of the Putnam-Wilson OCCI showed that 58 percent of the variance in 35 items could be accounted by three factors (Wilson & Waltman, 1988). Additionally, the fourth and fifth factors accounted for only nine percent additional variance and could not be delineated in a clear manner. Putnam and Wilson interpreted these three factors as non-confrontational strategies, solution-oriented strategies, and control strategies. Individuals with a non-confrontational style try to deal with conflict in an indirect manner. They ignore the conflict situation, or focus their attention away from the issue and refuse to deal with it. Individuals with solution-oriented style manage conflict by trying to arrive at a mutually satisfying solution through compromise. Individuals with a control style argue persistently for their point of view, do not concede to the opposing entity and do so using non-verbal messages to emphasize demands (Wilson & Waltman, 1988).

2.4. Assertiveness

Ames and Flynn (2007) view assertiveness as a critical factor in the effectiveness of a leader. Rather than concentrating on the strengths of an effective leader, Ames and Flynn (2007) concentrated their study on the weaknesses of an ineffective leader and found that the relationship between assertiveness and leadership effectiveness has a curvilinear nature. In their study, references to assertiveness were more prevalent in a negative context. Additionally, within the negative context, there were an equal number of subjects that referred to overassertiveness and underassertiveness. Subjects falling above and below the moderate levels of assertiveness had a negative correlation with conflict management, team behaviors, motivation, influence, overall current effectiveness, and expected future success (Ames & Flynn, 2007). Additionally, Thomas et al. (2008) found that higher hierarchical levels in organizations are associated with a higher level of assertiveness whereas new hires and non-supervisory level employees exhibited more frequent use of styles that are low on assertiveness, namely avoiding and accommodating.

Spurlock et al. (2008) studied data collection techniques in three prominent engineering management journals over a period of 10 years. Out of the 512 articles examined, only 24 percent were found to be of behavioral nature. Behavioral articles were classified as studies which focused primarily on the behavior of human beings. The two most common types of research methods used were questionnaires (70.6 percent), followed by interviews (19.8 percent). Out of the types of measures used for behavioral articles, “self-report” was the most common method used followed by reporting about a fellow co-worker, immediate supervisor, or something easily identifiable.

Rosenbaum (1991) believes that technical professions are unique enough to demand a specialized training for people who manage them. Although most engineering management researchers would agree with this statement, very few have conducted studies to collect empirical data. The researcher believes there are a number of articles in the pool of literature today about how an engineer can develop leadership skills, but most of them are based on opinions and not industry data. The results from this study will provide an insight into the interpersonal skills of entry level engineers as well as a quantitative comparison with their peers studying organizational leadership

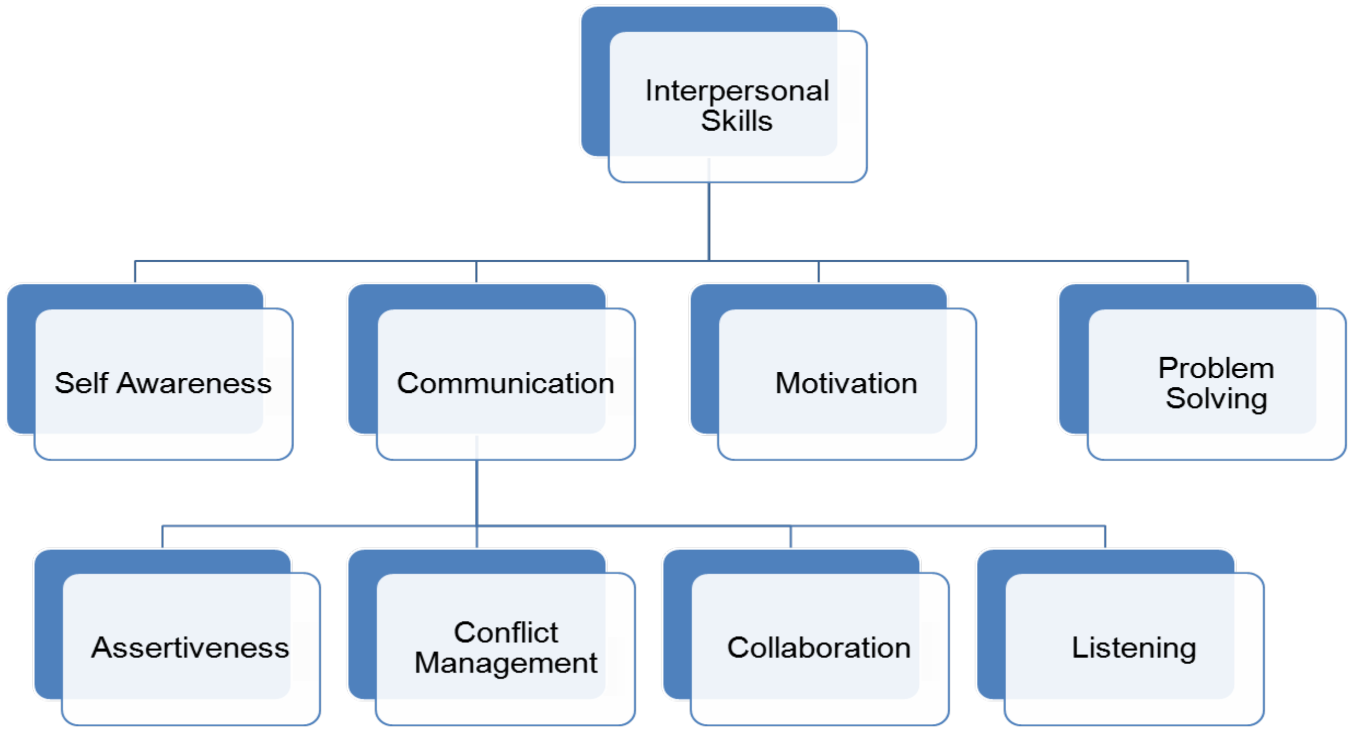

Figure 2.1 Classification of Interpersonal Communication Skills

2.5. Summary

A number of engineering managers are unsuccessful in their transition to management because they have traditionally been promoted on the merit of their contribution to the technical aspect of a project or an organization and have received no or little formal training in management or leadership. The increased demand of technical leaders in the future demands their current leadership styles be studied in order to incorporate some sort of training into their professional careers or even at the university level. Leadership covers a broad spectrum of skills and this chapter explained the specific interpersonal communication skills that the researcher will be studying.

CHAPTER 3. METHODOLOGY

This chapter talks about the proposed methodology of the study, its framework, and the data collection method used. Specifically, this study uses a quantitative approach and uses two surveys distributed through Purdue Qualtrics as a data collection tool.

3.1. Framework

This research will employ quantitative methods to collect data on interpersonal communication skills - namely assertiveness and conflict management styles. The study is non-experimental, and does not involve any variable manipulation and; hence, uses a descriptive study design. The interpersonal skills will be evaluated using two different surveys. Data will be collected through electronically distributed surveys using the Purdue Qualtrics system. The units of measurement will be individuals.

3.2. Survey Structure

3.2.1. Rathus Assertiveness Schedule

The Rathus Assertiveness Schedule is a broadly used self-assessment test used to measure the level of assertiveness of an individual. The survey consists of a set of thirty questions with answer choices ranging from +3 to -3 with the following scale:

- +3 = very much like me

- +2 = rather like me
- +1 = slightly like me
- -1 = slightly unlike me
- -2 = rather unlike me
- -3 = very much unlike me

Scores can range from +90 to -90. There is no demarcation of being overassertive or underassertive based on the score.

3.2.2. Putnam-Wilson OCCI

The conflict management style will be measured by the Putnam Wilson OCCI. This survey consists of a set of 30 questions, each question corresponding to a particular conflict management type (Non-confrontational, Solution-oriented, and Control). The answer choices and scores linked to each option are:

- 1 = always
- 2 = very often
- 3 = often
- 4 = sometimes
- 5 = seldom
- 6 = very seldom
- 7 = never

The subject will chose one of the seven options for each question. Upon completion, the survey will produce three separate scores for each subject. These scores will then be matched to a scale developed by the author of the survey which will provide insight into preferred, frequent, and infrequent uses of the different styles of conflict management. Additionally, means across the three scales will be compared for three groups based on gender, major, and work experience. For a more detailed representation of the scoring system, please see

Appendix E. The results may or may not present a trend in conflict management styles of the two majors.

3.3. Survey Distribution

An email was sent to the academic advisors of all the engineering departments and the department of OLS at Purdue University, which included a brief summary of the research being conducted and IRB approval. Upon receiving positive responses from Chemical Engineering, Civil Engineering, Construction Engineering and Management, Nuclear Engineering, Electrical and Computer Engineering, and OLS; electronic recruitment letters were sent to advisors which were to be forwarded to all seniors in their respective departments. The recruitment letter contained a summary of the research project, a link to the survey, and IRB requirements which stated that the survey was voluntary and the subjects had to be 18 and over to participate. The survey was prepared online using the Purdue Qualtrics System and distributed through a link in the electronic recruitment letter.

3.4. Analysis

An exploratory data analysis (EDA) was conducted with the help of basic descriptive statistics to reveal possible errors in data (outliers), features of the dataset (skew, symmetry, and scatter), to test if the dataset followed a normal distribution and determine if parametric or non-parametric tests should be used for further analysis. A factorial ANOVA was then conducted to determine the significance of relationships between the independent variables. If the relationships between two variables were found to be significant, a two-level t-test was conducted; else, an independent sample t-test was conducted.

For results from the Rathus Assertiveness Schedule, independent two sample t-tests were conducted on engineering versus OLS majors, respondents with internship experience versus those without internship experience, and male versus female. Additionally, the same tests were performed on scores from the college of Engineering.

The scores from the Putnam-Wilson OCCI were tested for independence using correlation tests, and normality using the Shapiro-Wilk test as a part of the exploratory data analysis. For normal samples, independent two sample t-tests were carried out for groups based on gender, major, and work experience.

3.5. Summary

This chapter summarizes the research methodology and data collection process. Specifically, the research will employ quantitative methods and will use a survey through Purdue Qualtrics as a data collection method. A three-part survey was used to measure each of the skills separately. The first part recorded information such as gender, major, and work experience; the second part measures assertiveness levels, and the third part recorded conflict management styles. Responses from the RAS were put through an EDA first, followed by a factorial ANOVA and significance tests. Responses from the Putnam-Wilson OCCI were also put through an EDA first, followed by correlation and significance tests. Means were compared based on major, gender, and work experience.

CHAPTER 4. RESULTS

The results from the data analysis are presented in this section. The survey was sent to seniors in the college of engineering and the OLS department. Although a total of 54 responses were recorded, only 36 were complete responses. The remaining 18 responses had a significant portion of the data missing and; therefore, could not be included in the analysis. Out of the 36 complete responses, 28 were from the College of Engineering and the remaining eight were from the OLS department. The response rates could not be calculated for either of the majors as the number of seniors the survey was sent to was not available to the researcher. The survey had a balanced response in terms of gender, with 17 of the respondents being female and the remaining 19 being male. Twenty one of the respondents are not pursuing any other area of study as a minor while the remaining 15 are pursuing one or more area of study as minors. Out of the 36 respondents, 13 had no internship or co-op experience, eight had up to three months of work experience, 12 had between six to nine months, and two had above nine months of work experience.

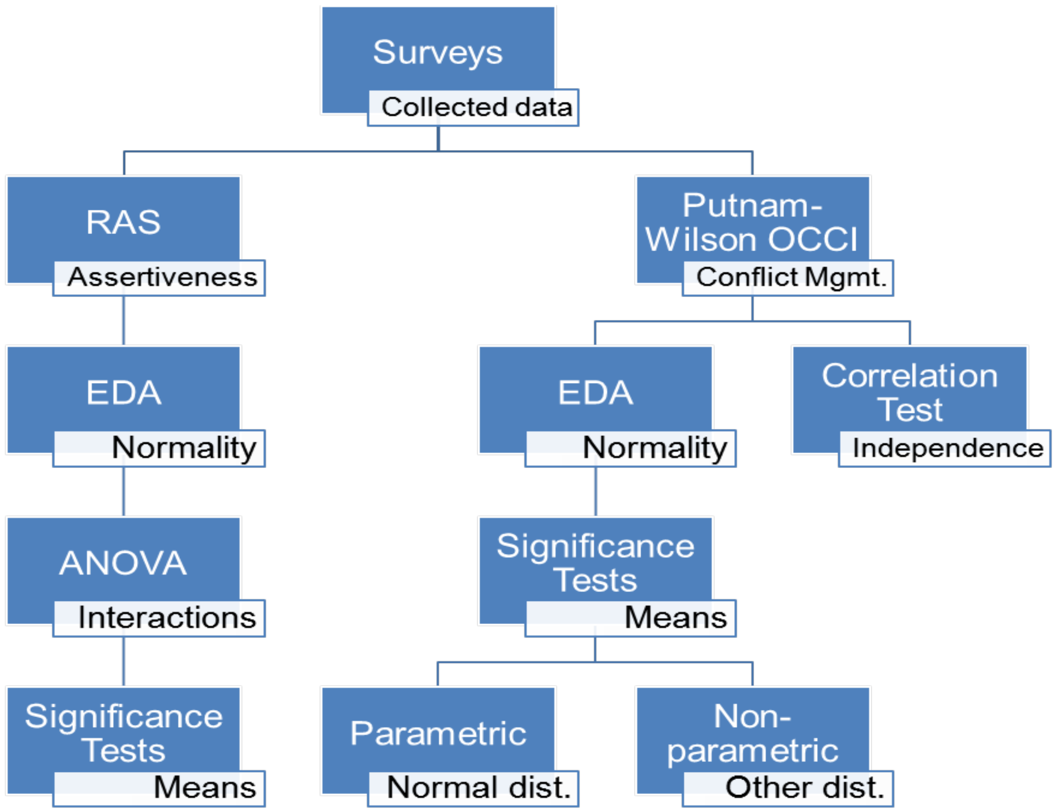

Figure 4.1 Data Analysis Chart

4.1. Assertiveness

An analysis of the data obtained through the Rathus Assertiveness Schedule is presented in this section.

4.1.1. Exploratory Data Analysis

The preliminary analysis included using descriptive statistics to gain a basic understanding of the RAS distribution. This analysis included checking for outliers, calculating the mean, median, mode, skewness, and kurtosis of the distribution.

4.1.1.1. Overall RAS Responses

The descriptives of all the RAS responses can be seen in Table 4.1. This table provides a general look at the distribution of the Rathus Assertiveness Schedule responses collected from all the 36 respondents.

Table 4.1 Descriptives - Overall RAS Responses

			Statistic	Std. Error
RAS	Mean		8.22	3.891
	95% Confidence Interval for Mean	Lower Bound	0.32	
		Upper Bound	16.12	
	Median		7.50	
	Variance		545.149	
	Std. Deviation		23.348	
	Minimum		-37	
	Maximum		54	
	Range		91	
	Skewness		-0.172	0.393
	Kurtosis		-0.453	0.768

The results for normality tests conducted on all of the RAS responses can be seen in Table 4.2. It should be noted that the Kolmogorov-Smirnov test is used for sample sizes of above 50, while the Shapiro-Wilk test is used for sample sizes of below 50. The significance value from the Shapiro-Wilk test, which is greater than 0.05, indicates the normality of the overall RAS responses distribution.

Table 4.2 Normality Test – Overall RAS Responses

	Shapiro-Wilk		
	Statistic	df	Sig.
RAS	0.977	36	0.652

Figure 4.2 provides the frequency count of the responses while showing the skewness of the distribution while Figure 4.3 is a normal Q-Q plot which graphically represents the normality of the RAS response distribution.

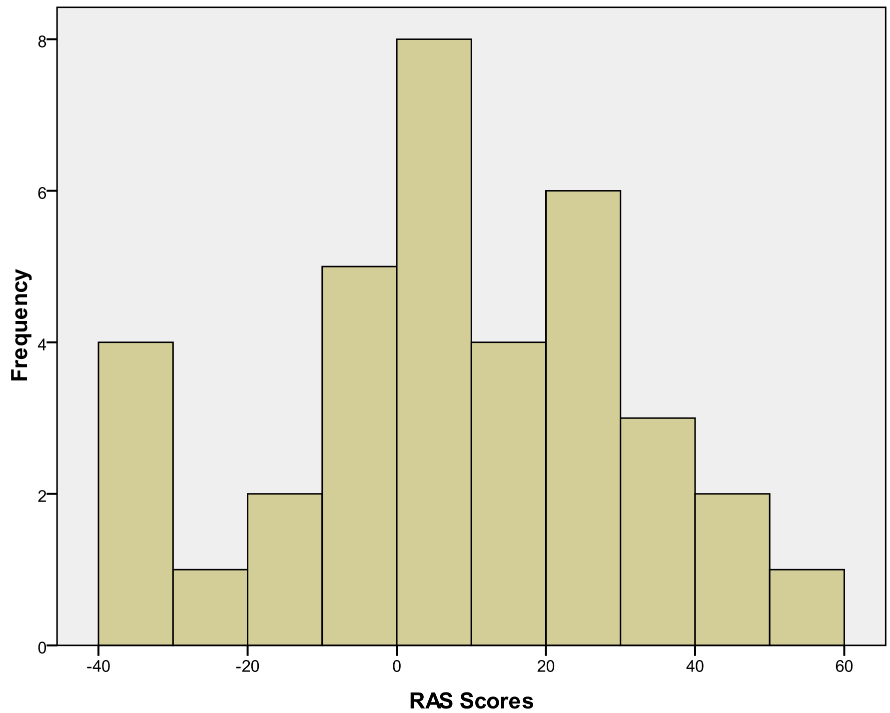

Figure 4.2 Histogram – Overall RAS Distribution

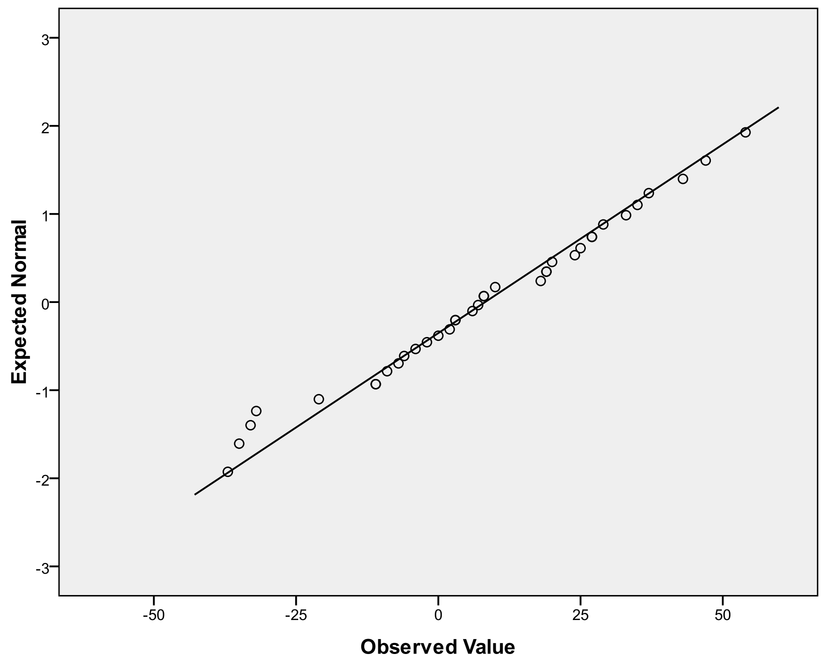

Figure 4.3 Q-Q Plot – Overall RAS Responses

Figure 4.4 is a boxplot of the distribution and shows that observation 14 is an outlier. Observation 14 had an assertiveness score of -33, which was recorded as the minimum in the distribution.

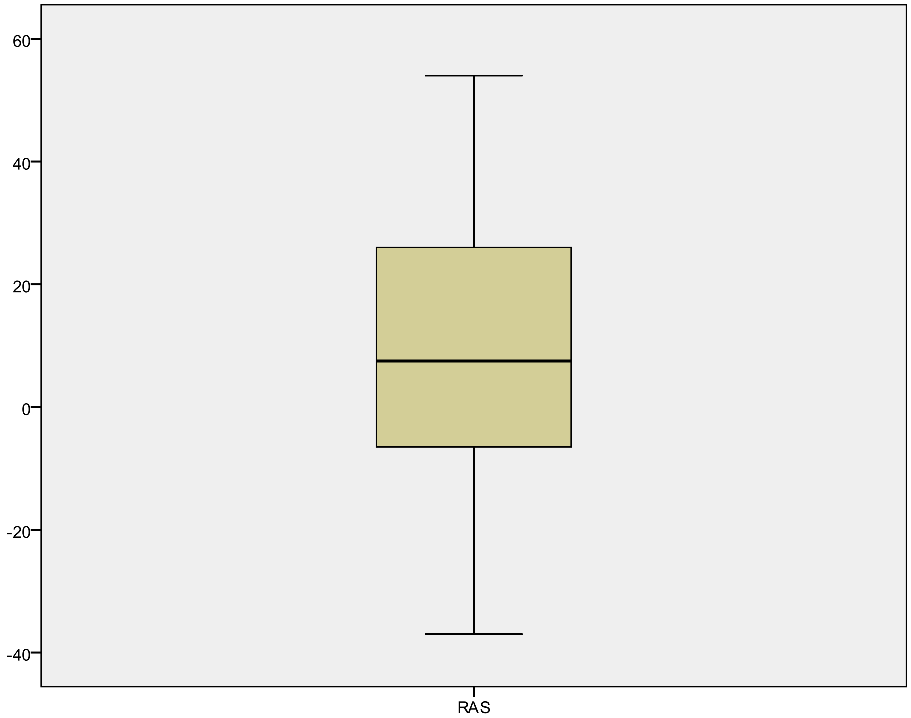

Figure 4.4 Boxplot – Overall RAS Distribution

4.1.1.2. College of Engineering

Table 4.3 provides data on the descriptives of responses collected from the College of Engineering only. It was found that the mean of responses from this sample was lower as compared to the overall RAS response mean. Additionally, the skewness was found to be positive which implies that a majority of the engineering responses were to the left of the median.

Table 4.3 Descriptives – RAS Responses (COE)

			Statistic	Std. Error
RAS	Mean		1.11	2.784
	95% Confidence Interval for Mean	Lower Bound	-4.60	
		Upper Bound	6.82	
	5% Trimmed Mean		1.29	
	Median		0.00	
	Variance		216.988	
	Std. Deviation		14.731	
	Minimum		-33	
	Maximum		29	
	Range		62	
	Interquartile Range		16	
	Skewness		0.045	0.441
	Kurtosis		0.156	0.858

The Shapiro-Wilk test for normality yielded a significance value greater than 0.05, which indicates that the distribution follows a normal curve. These values are shown in Table 4.4.

Table 4.4 Normality Test – RAS Responses (COE)

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
RAS	0.120	28	0.200	0.968	28	0.531

Figure 4.5, Figure 4.6, and Figure 4.7 represent the distribution graphically display a frequency count, the normality of the distribution, and a boxplot with the outlier respectively. As previously stated, the observation with a value of -33 was deemed an outlier.

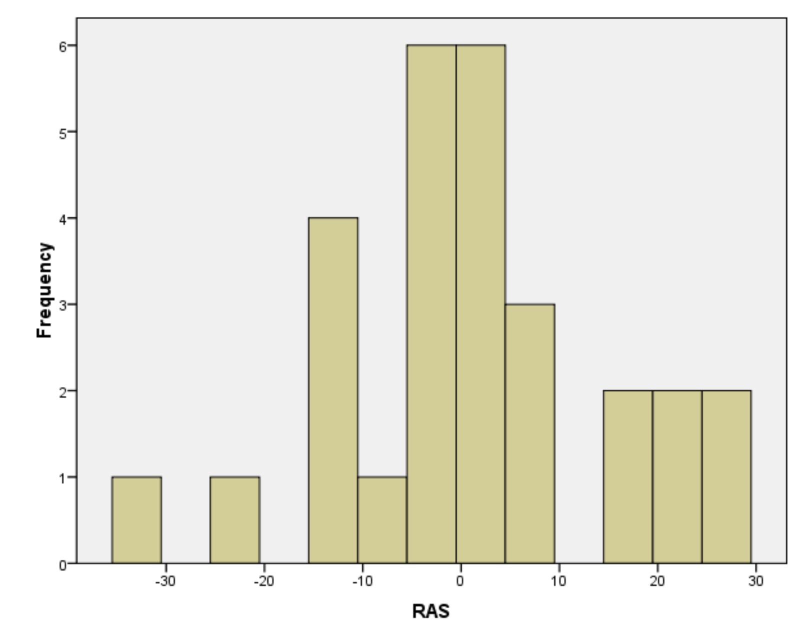

Figure 4.5 Histogram – RAS Distribution (COE)

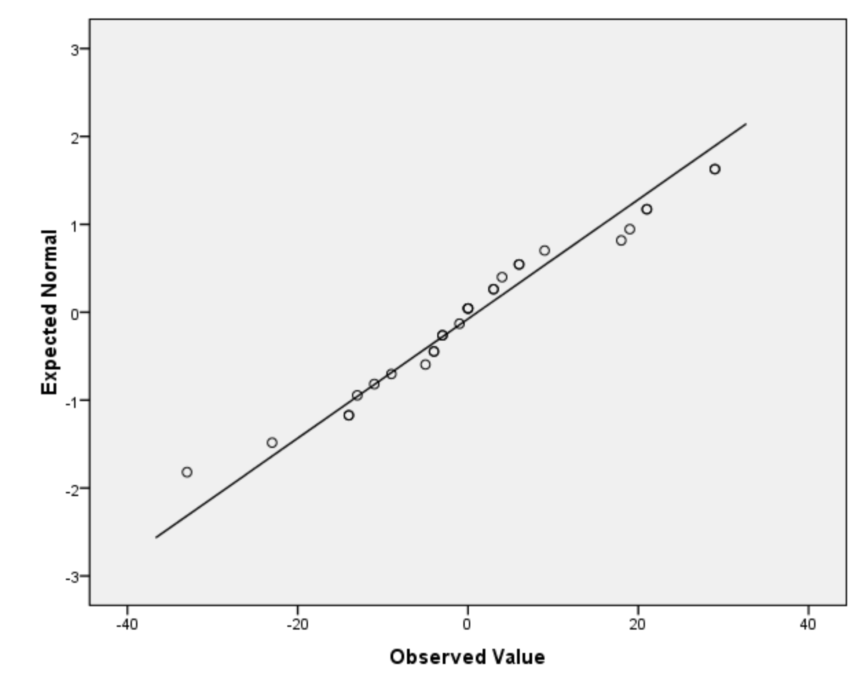

Figure 4.6 Q-Q Plot – RAS Distribution (COE)

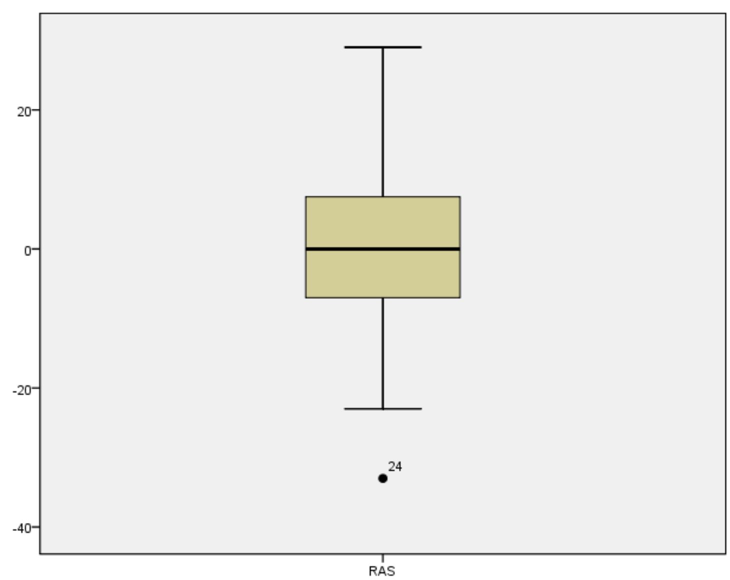

Figure 4.7 Boxplot – RAS Distribution (COE)

4.1.2. Factorial Analysis of Variance

A three-way ANOVA was conducted to test the significance of interactions between gender, major, and work experience; and their effect on the assertiveness score. These tests were conducted at an alpha level of 0.05. Table 4.5 summarizes the results from the ANOVA. None of the interactions were found to be significant (p>0.05).

Table 4.5 ANOVA Results – Overall RAS Responses

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4066.552	6	677.759	1.309	0.285
Intercept	3066.572	1	3066.572	5.923	0.021
Sex	345.093	1	345.093	0.667	0.421
Major	1058.512	1	1058.512	2.045	0.163
WX	61.744	1	61.744	0.119	0.732
Sex * Major	88.167	1	88.167	0.170	0.683
Sex * WX	1590.000	1	1590.000	3.071	0.090
Major * WX	335.185	1	335.185	0.647	0.428
Sex * Major * WX	0.000	0	.	.	.
Error	15013.670	29	517.713		
Total	21514.000	36			
Corrected Total	19080.222	35			

4.1.3. Independent Sample t-tests

The independent sample t-tests were conducted on the overall sample (N = 36), as well as responses within the college of Engineering only (N = 28). This analysis could not be conducted on responses from the OLS Department due to a very small sample size (N = 8).

4.1.3.1. Overall RAS Responses

Data from the original sample as well as the engineering subset was found to follow a normal distribution. Therefore, the independent sample parametric t-test was chosen to compare means between two groups and test the significance of the difference. The groups from the main sample (with N = 36) were divided based on major (engineering versus OLS), work experience through internships or co-ops, and gender. Groups from the engineering subset (N = 28) included comparing male versus female engineers, and engineers with work experience against engineers without work experience. The null and the alternate hypotheses remained constant throughout the tests, which were as follows:

H_o: The mean of group 1 is equal to the mean of group 2, $\mu_1 - \mu_2 = 0$.

H_α: The mean for group 1 is not equal to the mean of group 2, $\mu_1 - \mu_2 \neq 0$.

Table 4.6 provides the group statistics when the two majors were compared.

Table 4.6 Group Statistics – COE vs. OLS

	Major	N	Mean	Std. Deviation	Std. Error Mean
RAS	Engineering	28	5.25	24.359	4.603
	OLS	8	18.63	16.673	5.895

Table 4.7 Normality Test – COE vs. OLS

		Shapiro-Wilk		
	Major	Statistic	df	Sig.
RRAS	OLS	0.975	8	0.932
	Engineering	0.975	28	0.720

Table 4.7 shows the results of the Shapiro-Wilk normality test conducted on a sample based on major. The significance values are greater than 0.05 which provides evidence that the sample scores follow a normal distribution.

Therefore further analysis can be performed on this sample using a parametric test.

Table 4.8 Two-sample t-test results – COE vs. OLS

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
RAS	Equal var assumed	-1.451	34	0.156	-13.375	9.216
	Equal var not assumed	1.788	16.546	0.092	-13.375	7.479

The independent samples test results can be seen in Table 4.8. Since the significance values are greater than 0.05, we fail to reject the null hypothesis; that is, we do not have sufficient evidence to suggest that the difference in the means of RAS scores of engineers and OLS majors is statistically significant.

Table 4.9 provides the group statistics when the sample was divided into two groups based on their work experience. Thirteen of the respondents did not have any work experience; whereas, the remaining 23 respondents had work experience that varied from two months up to 20 months.

Table 4.9 Group Statistics – Work Experience

	Work Experience	N	Mean	Std. Deviation	Std. Error Mean
RAS	Yes	23	7.74	24.182	5.042
	No	13	9.08	22.732	6.305

Table 4.10 Normality Test – Work Experience

	Work Experience	Shapiro-Wilk Statistic	Df	Sig.
RAS	No	0.968	13	0.872
	Yes	0.970	23	0.693

The significance values of the Shapiro-Wilk test are greater than 0.05 for both the samples (Table 4.10) which implies that the sample scores follow a normal distribution. Therefore a parametric test can be performed on this sample.

Table 4.11 Two-sample t-test Result – Work Experience

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
RAS	Equal var. assumed	-0.163	34	0.872	-1.338	8.217
	Equal var. not assumed	-0.166	26.374	0.870	-1.338	8.073

The significance values of the distribution are greater than 0.1 regardless of the equal variance assumption (Table 4.11). Therefore we fail to reject the null hypothesis; that is, we do not have sufficient evidence that the difference in means of the RAS scores of students with and without work experience is statistically significant.

Table 4.12 presents the group statistics when the sample was divided into two groups based on gender. The overall sample contained 19 male respondents and 17 female respondents.

Table 4.12 Group Statistics - Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
RAS	Male	19	6.47	22.087	5.067
	Female	17	10.18	25.220	6.117

Table 4.13 presents the results of the normality test performed on these samples based on gender. As the significance value indicates ($p > 0.05$), the sample scores follow a normal distribution. Therefore a parametric test can be performed on this sample.

Table 4.13 Normality Test - Gender

		Shapiro-Wilk		
	Gender	Statistic	df	Sig.
RAS	Female	0.969	17	0.795
	Male	0.965	19	0.665

Although the means look significantly different, an independent sample test did not provide sufficient evidence to prove that the difference is statistically significant. Results of the independent sample test are provided in Table 4.14.

Table 4.14 Two-Sample t-test Result - Gender

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
RAS	Equal var. assumed	-0.470	34	0.642	-3.703	7.883
	Equal var. not assumed	-0.466	32.070	0.644	-3.703	7.943

4.1.3.2. College of Engineering

Table 4.15 provides the group statistics for responses based on gender from the college of Engineering alone. There were 17 male respondents from the college of Engineering and 11 female respondents. Even though the means appear to be significantly different, an independent sample test reveals the difference in means is not statistically significant. The scores for this sample were found to be normal (Table 4.16). The significance values for equal and unequal variance assumption are both greater than 0.1 (see Table 4.17). However, the difference becomes significant once the outlier stated above is removed from consideration while performing the t-test. The p-values for the scenario were computed to be 0.078 and 0.068 for equal and unequal variance assumptions respectively. The results from this test can be found in Table 4.18 (group statistics) and Table 4.20 (t-test results). This result implies that assertiveness behaviors are significantly different in male and female engineers with a senior academic standing.

Table 4.15 Group Statistics – Gender (COE)

	Gender	N	Mean	Std. Deviation	Std. Error Mean
RAS	Male	17	2.76	19.995	4.850
	Female	11	9.09	30.589	9.223

Table 4.16 Normality Test – Gender (COE)

		Shapiro-Wilk		
	Gender	Statistic	Df	Sig.
RAS	Female	0.938	11	0.495
	Male	0.947	17	0.406

Table 4.17 Two-Sample t-test Result – Gender (COE)

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
RAS	Equal variances assumed	-0.664	26	0.512	-6.326	9.525
	Equal variances not assumed	-0.607	15.551	0.553	-6.326	10.420

Table 4.18 Group Statistics (Outlier Excluded) – Gender (COE)

	Gender	N	Mean	Std. Deviation	Std. Error Mean
RAS	Male	15	7.93	14.611	3.773
	Female	11	9.09	30.589	9.223

Table 4.19 Normality Test (outlier Excluded) – Gender (COE)

		Shapiro-Wilk		
	Gender	Statistic	df	Sig.
RAS	Female	0.938	11	0.495
	Male	0.920	15	0.191

Table 4.20 Two-Sample t-test Result (Outlier Excluded) – Gender (COE)

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
RAS	Equal var. assumed	-0.129	24	0.899	-1.158	9.003
	Equal var. not assumed	-0.116	13.359	0.909	-1.158	9.965

4.2. Conflict Management

The Putnam-Wilson OCCI was used to determine the preferred conflict management style of the respondents. A frequency count was done to determine if the respondents' scores fell in the upper, middle, or lower third in each of the three conflict management scales. Table 4.21 summarizes the frequency count, giving the score range for each of the scales.

Table 4.21 Frequency Count – Putnam-Wilson OCCI

Solution Oriented	Score range	Count OLS	COE	Total
Lower 1/3rd	16-27	0	2	2
Middle	28-39	7	20	27
Upper 1/3rd	40-49	1	6	7
Non-Confrontational	Score Range	Count OLS	COE	Total
Lower 1/3rd	10-34	0	1	1
Middle	35-59	4	17	21
Upper 1/3rd	60-84	4	10	14
Control	Score Range	Count OLS	COE	Total
Lower 1/3rd	10-23	0	4	4
Middle	24-36	6	19	25
Upper 1/3rd	37-49	2	5	7

Table 4.22 presents the results of the correlation test that was performed on the three conflict management scales to determine whether the sample

scores were dependent or independent. All significance values were found to be greater than 0.05 which means that no significant correlation was found between any of the scales and the scores were independent of each other. The correlation was performed to determine if dependent or independent tests would be used to further analyze the data.

Table 4.22 Correlation Test

		SO	NC	Control
SO	Pearson Correlation	1	0.193	-0.219
	Sig. (2-tailed)		0.259	0.200
	N	36	36	36
NC	Pearson Correlation	0.193	1	0.010
	Sig. (2-tailed)	0.259		0.955
	N	36	36	36
Control	Pearson Correlation	-0.219	0.010	1
	Sig. (2-tailed)	0.200	0.955	
	N	36	36	36

4.2.1. Exploratory Data Analysis

Table 4.23 shows the group statistics from the overall sample and the college of Engineering subset of each of the conflict scale. It should be noted that the mean values were similar to the values found in the original study. The original study had 360 respondents and the corresponding means for non-confrontation, solution orientation, and control scales were 55, 36, and 32 respectively.

Table 4.23 Group Statistics – Putnam-Wilson OCCI

	Major	N	Mean	Std. Deviation	Std. Error Mean
Solution Oriented Total	OLS	8	32.7500	4.97853	1.76017
	Engineering	28	35.0714	6.50315	1.22898
Non-Confrontational	OLS	8	57.5000	8.12404	2.87228
	Engineering	28	54.3214	11.39543	2.15353
Control	OLS	8	31.3750	4.89716	1.73141
	Engineering	28	30.3929	5.39780	1.02009

The exploratory data analysis conducted on the overall sample and engineering subset h brought to attention that the distributions were normal. Table 4.24, Table 4.25, and Table 4.26 show the results from the normality tests for groups based on gender, major, and work experience. With the exception of males for the non-confrontational scale, and both the majors for the solution oriented scale, all scores were found to follow a normal distribution (significance value > 0.05). Therefore independent sample t- tests and non-parametric tests were used to test the significance depending on the normality of the sample.

Table 4.24 Normality Test - Gender

		Shapiro-Wilk		
	Gender	Statistic	df	Sig.
Solution Oriented Total	Female	0.892	17	0.051
	Male	0.907	19	0.065
Non-Confrontational	Female	0.951	17	0.469
	Male	0.892	19	0.035
Control	Female	0.915	17	0.121
	Male	0.929	19	0.164

Table 4.25 Normality Test - Major

		Shapiro-Wilk		
	Major	Statistic	df	Sig.
Solution Oriented Total	OLS	0.787	8	0.021
	Engineering	0.921	28	0.037
Non-Confrontational	OLS	0.958	8	0.787
	Engineering	0.967	28	0.501
Control	OLS	0.924	8	0.460
	Engineering	0.955	28	0.257

Table 4.26 Normality Test – Work Experience

		Shapiro-Wilk		
	Work Experience	Statistic	df	Sig.
SO	No	0.964	13	0.815
	Yes	0.939	23	0.167
NC	No	0.931	13	0.347
	Yes	0.966	23	0.589
Control	No	0.896	13	0.117
	Yes	0.966	23	0.603

4.2.2. Significance Tests

Independent sample t-tests were performed on scores that were normal. Means were compared between males and females, OLS and engineering majors, and students with work experience and students without work experience.

Table 4.27 and Table 4.28 present data on group descriptives and the results from the t-tests that were performed on two of the scales, as the non-confrontational scale scores were not found to follow a normal distribution. The difference in mean scores of males and females was found to be significant at an alpha level of 0.05 under the control scale whereas there was insufficient evidence to prove that the means were different under the solution oriented scale.

Table 4.27 Group Descriptives - Gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Solution Oriented Total	Male	19	34.4737	6.95516	1.59562
	Female	17	34.6471	5.46513	1.32549
Control	Male	19	28.4737	4.98184	1.14291
	Female	17	33.0000	4.54148	1.10147

Table 4.28 Two-Sample t-test Result - Gender

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
SO	Equal var. assumed	-0.082	34	0.935	-.17337	2.10259
	Equal var. not assumed	-0.084	33.479	0.934	-.17337	2.07435
Control	Equal var. assumed	-2.837	34	0.008	-4.52632	1.59569
	Equal var. not assumed	-2.852	33.984	0.007	-4.52632	1.58729

Table 4.29 and Table 4.30 present group descriptives and t-test results for groups based on major. For this group, the control and non-confrontational scale scores were found to follow a normal distribution. It is evident from the significance values ($p > 0.05$) that the means for this group under these scales are not significantly different.

Table 4.29 Group Descriptives - Major

	Major	N	Mean	Std. Deviation	Std. Error Mean
Control	Engineering	28	30.3929	5.39780	1.02009
	OLS	8	31.3750	4.89716	1.73141
NC	Engineering	28	54.3214	11.39543	2.15353
	OLS	8	57.5000	8.12404	2.87228

Table 4.30 Two-Sample t-test Result - Major

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Control	Equal var. assumed	-0.462	34	0.647	-0.98214	2.12416
	Equal var. not assumed	-0.489	12.318	0.634	-0.98214	2.00956
NC	Equal var. assumed	-0.734	34	0.468	-3.17857	4.33091
	Equal var. not assumed	-0.885	15.789	0.389	-3.17857	3.58995

Table 4.31 and Table 4.32 present the group descriptives and t-test results for groups based on work experience. As is evident from the significance values from the t-test results, the difference in means under all the three scales was not found to be significant. ($p > 0.05$).

Table 4.31 Group Descriptives – Work Experience

	Work Experience	N	Mean	Std. Deviation	Std. Error Mean
Control	Yes	23	30.3913	5.14993	1.07383
	No	13	31.0000	5.58271	1.54837
NC	Yes	23	57.0870	9.45762	1.97205
	No	13	51.3846	12.22387	3.39029
SO	Yes	23	35.1739	4.09714	0.85431

	Work Experience	N	Mean	Std. Deviation	Std. Error Mean
Control	Yes	23	30.3913	5.14993	1.07383
	No	13	31.0000	5.58271	1.54837
NC	Yes	23	57.0870	9.45762	1.97205
	No	13	51.3846	12.22387	3.39029
SO	Yes	23	35.1739	4.09714	0.85431
	No	13	33.4615	8.92203	2.47453

Table 4.32 Two-Sample t-test Result – Work Experience

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
SO	Equal var. assumed	0.791	34	0.435	1.71237	2.16575
	Equal var. not assumed	0.654	14.916	0.523	1.71237	2.61785
NC	Equal var. assumed	1.563	34	0.127	5.70234	3.64941
	Equal var. not assumed	1.454	20.231	0.161	5.70234	3.92213
Control	Equal var. assumed	-0.331	34	0.743	-.60870	1.84137
	Equal var. not assumed	-0.323	23.371	0.750	-.60870	1.88429

4.3. Summary

This section presented the results of the responses obtained through the RAS and Putnam-Wilson OCCI. Statistical analyses of the results included performing an EDA to determine normality, ANOVA to check for significant interactions between gender, major, and work experience, correlation tests to identify if the scores were independent of each other, and parametric as well as non-parametric tests to check for significant differences in the means between two groups.

CHAPTER 5. DISCUSSION, RECOMMENDATIONS, AND CONCLUSION

An interpretation of the above results is provided in this section along with recommendations for future research and a brief summary of the study.

5.1. Discussion of Results

A major limitation of the study was the limited number of responses. The small number of responses posed an issue with the exploratory data analysis. One of the major parts of the EDA was to figure out whether to use parametric or non-parametric tests. This choice depended on if the distributions were normal. Even though the Shapiro-Wilk tests showed the distribution to be normal, it could be misleading since small sample sizes almost always show a normal distribution. A possible solution to correct the normality issue would be to use non-parametric tests, but the sample size, especially the OLS subset, might not have provided accurate results.

The EDA provided descriptives of the distribution including the Shapiro-Wilk test, a histogram, a Q-Q plot, and a boxplot. The graphical representations reinforced the results from the Shapiro-Wilk test, stating the distributions were normal. Once the distributions were deemed as normal, an independent two sample t-test was carried out between different groups based on major, gender, and work experience to compute if the difference in their means was statistically significant. For measuring the assertiveness, the Rathus Assertiveness Schedule was used, and means between Engineering and OLS majors, students with work experience and without work experience, and males and females, respectively, were compared and tested. For the first test case, no statistically significant difference between the mean scores or the two majors was found which indicates there is not enough statistical evidence to prove the level of assertiveness of seniors in engineering majors is different from that of seniors from the OLS major. Similarly, no statistically significant difference was found between students with work experience as compared to students without work experience, and between males and females. Additionally, these results extended to the college of Engineering sample as well. However, with the exclusion of the outlier identified in the EDA, the difference in assertiveness level between male and female engineers was found to be significant. With the exception of this case, the non-significant results can be attributed to two factors, the first being insufficient data which reflects a lack of representation of the population, and the second factor being geographical limitations of the research since this study was only open to students from the West Lafayette campus of Purdue University. Regional differences in assertiveness level have been studied before (Sigler, Burnett, & Child, n.d.) and it was noted that university students from the upper Midwest had significantly lower assertiveness levels than students from the State of New York. Sigler et al (n.d.) found that there was no significant difference in the assertiveness levels of the same gender from the same region. Hence, the geographical limitation of the study could be a factor in the lack of difference in means. However, Sigler et al (n.d) did find a significant difference in assertiveness between males and females from the same region, which is supported by the results from the college of Engineering. The researcher believes that a larger OLS sample would have given similar results to the study conducted by Sigler et al (n.d).

Due to the limitation in the OLS sample size, analysis of the Putnam-Wilson OCCI could not provide any conclusive results for that particular subset. Upon comparing the responses recorded from the college of Engineering to the scale provided by the survey, two students were found to use the solution oriented approach to conflict management frequently, whereas two others scored in the “infrequently used” range. Under the non-confrontational scale, only one student scored in the “frequently used” range, whereas another scored in the "infrequently used" range. For the third scale, control, four students scored in the "frequently used" range and there were no infrequent users. Due to such small sample sizes in each category, it is extremely difficult to generalize the characteristics of the student who scored in a particular category to an entire population.

From the significance tests, a significant difference in means was found in the control scale of conflict management between males and females. The mean for females was higher, which indicates that females use this style less frequently than males. Since the difference in assertiveness levels was also found based on a gender sample, a correlation test was performed between RAS scores and Control scale scores. The results indicated that the relationship was significant at the 90 percent significance level for both, the overall sample ($p = 0.098$), and the sample from COE ($p = 0.095$). This result can be expected as an individual who uses control style for conflict management is known to be highly assertive.

5.2. Recommendations for future research

The research areas of assertiveness levels and conflict management styles in engineers need a more in-depth understanding, and this study can be used as a stepping stone to do so. For future studies relating to these topics, a more diverse sample should be considered, both academically and geographically. The inclusion of sophomores, juniors, and seniors, as well as entry level employees, will give the researcher a rich amount of data to work with. In addition to the larger sample size, researchers may find trends within the samples and may be able to extrapolate them to identify the future strengths and weaknesses. A larger picture would include researchers developing a model to accurately identify and rate communication skills in students and provide them with the necessary training along the path so as to convert their communication weaknesses into strengths.

5.3. Conclusion

The topic of engineers lacking interpersonal communication skills has been greatly talked about, but little attention has been given to the collection of empirical evidence to support the claim. As stated earlier, interpersonal skills involve a lot of different dimensions, one of which is communication. Even interpersonal communication can be broken down into various aspects like assertiveness, conflict management, active listening, and collaboration skills. Empirical evidence needs to be gathered in each of these areas to gain a greater understanding of the difference in communication skills between professions, especially technical professionals as the training developed through research in these areas can greatly benefit technical professionals when they step into the industry as entry-level engineers, as well as further down their career path when they are ready to take on leadership responsibilities.

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APPENDICES

Appendix A.

Institutional Review Board Approval

IRB Approval

Subject	**IRB Approval 1002009011 "Differences in Interpersonal Communication Skills..."**
From	Berry, Erica L
To	Vandeveer, Rodney C
Cc	Mhaskar, Anuj A
Sent	Wednesday, March 03, 2010 9:47 AM

The IRB has reviewed your Research Exemption Request titled, "Differences in Interpersonal Communication Skills... ", Ref. #1002009011 and deem it to be exempt. A copy of the approved letter will be forthcoming via campus mail. Good luck on your research.

Erica L. Berry
Human Research Protection Program
Purdue University
Ernest C. Young Hall
10th Floor, Room 1032
155 S. Grant Street
West Lafayette, IN 47907-2114
PH: 765/494-7090
FAX: 765/494-9911
http://www.irb.purdue.edu

Appendix B.

Survey Recruitment Letter

Survey Recruitment Letter

Dear Senior,

I am a graduate student in the department of Organizational Leadership and Supervision. I am currently researching the differences in assertiveness and conflict management styles between engineers and leadership majors as a part of my directed project.

I am using Purdue Qualtrics to collect data and would greatly appreciate it if you could take some time out of your schedule to complete the survey. The link to the survey is provided below.

I wish you the best for the remainder of your senior year, and once again, thank you for your help.

Survey Link:
<Survey Link>

Please note that you need to be 18 years of age or older to take the survey. This survey is voluntary and will not affect your grades in any manner.

Sincerely,

Anuj Mhaskar

Graduate Research Assistant
Organizational Leadership & Supervision
Purdue University, West Lafayette
Email: amhaskar@purdue.edu
Phone: (765)409-3420

Appendix C.

Rathus Assertiveness Schedule

Rathus Assertiveness Schedule

1. Most people seem to be more aggressive and assertive than I am. __
2. I have hesitated to make and accept dates because of “shyness”. __
3. When the food served at a restaurant is not done to my satisfaction, I complain about it to the waiter or waitress. __
4. I am careful to avoid hurting other people’s feelings, even when I feel that I have been injured. __
5. If a salesperson has gone to considerable trouble to show me merchandise that is not quite suitable, I have a difficult time saying “No”. __
6. When I am asked to do something, I insist upon knowing why. __
7. There are time when I look for a good, vigorous argument. __
8. I strive to get ahead as well as most people in my position. __
9. To be honest, people often take advantage of me. __
10. I enjoy starting conversations with new acquaintances and strangers. __
11. I often don’t know what to say to people I find attractive. __
12. I will hesitate to make phone calls to business establishments and institutions. __
13. I would rather apply for a job or for admission to a college by writing letters than by going through with personal interviews. __
14. I find it embarrassing to return merchandise. __
15. If a close and respected relative were annoying me, I would smother my feelings rather than express my annoyance. __
16. I have avoided asking questions for fear of sounding stupid. __
17. During an argument, I am sometimes afraid that I will get so upset that I will shake all over. __
18. If a famed and respected lecturer makes a comment which I think in incorrect, I will have the audience hear my point of view as well. __
19. I avoid arguing about prices with clerks and salespeople. __
20. When I have done something important or worthwhile, I manage to let others know about it. __
21. I am open and frank about my feelings. __
22. If someone has been spreading false and bad stories about me, I see him or her as soon as possible and “have a talk” about it. __
23. I often have a hard time saying “No”. __
24. I tend to bottle up my emotions rather than make a scene. __
25. I complain about poor service in a restaurant and elsewhere. __
26. When I am given a compliment, I sometimes just don’t know what to say. __
27. If a couple near me in a theatre or at a lecture were conversing rather loudly, I would ask them to be quiet or to take their conversation elsewhere. __
28. Anyone attempting to push ahead of me in line is in for a good battle. __
29. I am quick to express my opinion. __
30. There are time when I just can’t say anything. __

Appendix D.

Putnam-Wilson OCCI

Putnam-Wilson OCCI

1. I blend my ideas with my team members to create new alternatives for resolving a disagreement.
2. I shy away from topics which are sources of disputes with my team members.
3. I make my opinion known in a disagreement with my team members.
4. I suggest solutions that combine a variety of viewpoints.
5. I steer clear of disagreeable situations.
6. I give in a little on my ideas when my team members also give in.
7. I avoid my team members when I suspect that they want to discuss a disagreement.
8. I integrate arguments into a new solution from the issues raised in a dispute with my team members.
9. I will go 50 – 50 to reach a settlement with my team members.
10. I raise my voice when I'm trying to get my team members to accept my position.
11. I offer creative solutions in discussions of disagreements.
12. I keep quiet about my views in order to avoid disagreements.
13. I give in if my team members will meet me halfway.
14. I downplay the importance of a disagreement.
15. I reduce disagreements by making then seem insignificant.
16. I meet my team members at a mid-point in our differences.
17. I assert my opinion forcefully.
18. I dominate arguments until my team members understand my position.
19. I suggest we work together to create solutions to disagreements.
20. I try to use my team member's ideas to generate solutions to problems.
21. I offer trade-offs to reach solutions in a disagreement.
22. I argue insistently for my stance.
23. I withdraw when my team members confront me about a controversial issue.
24. I side-step disagreements when they arise.
25. I try to smooth over disagreements by making them appear unimportant.
26. I insist my position be accepted during a disagreement with my team members.
27. I make our differences seem less serious.
28. I hold my tongue rather than argue with my team members.
29. I ease conflict by claiming our differences are trivial.
30. I stand firm in expressing my viewpoints during a disagreement with my team members.

Appendix E.

Putnam-Wilson OCCI Scoring Methodology

Putnam-Wilson OCCI Scoring Methodology

The following items are added for each scale to produce three separate scores for each individual:

Non-Confrontation…………………………………..2,5,7,12,14,15,23,24,25,27,28,29

Solution Orientation

Confrontation ……………………………………………………….1,4,8,11,19,20

Compromise ……………………………………………………………6,9,13,16,21

Control…………………………………………………………………3,10,17,18,22,26,30